CYCLIC VEGETATION PATTERN IN THE SOUTHERN SIMPSON DESERT

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Summary

FATCHEN, T. J. & BARKER, S. (1979) Cyclic vegetation pattern in the southern Simpson Desert. *Trans. R. Soc. S. Aust.* **103**(5), 113-121, 31 August, 1979.

Local vegetation patterns in the Simpson Desert were objectively examined at seven sites near Lat. 26°S. The vegetation at most sites comprised a continuum of species, usually of regular cycle across dunes and related to soil stablity. Variation in soil type was subordinate to soil stability in influence on vegetation.

Differences were found in the pattern of vegetation between sites due to variations in the species present, landform and, on Desert margins, domestic stock grazing. The effects of domestic stock grazing suggest that plant cover contributes more to the landscape's stability than is thought by some authors.

No regular vegetation pattern was found in the central Desert where dunes were less regular and less mobile than elsewhere. Also *Triodia basedowii* was absent, though normally regarded as typical of the Desert. These characteristics appear more significant in the southern Desert than is reported for the northern part, and represent the main landscape heterogeneity found during the study.

Introduction

The vegetation of the Simpson Desert has received scant attention since the initial study by Crocker (1946). Further detailed reports comprise only the single site studies of Boyland (1970) and Wiedemann (1971). The mapping of Perry *et al.* (1962), Specht (1972) and Laut *et al.* (1977) provides information in broad terms only, much of it derived from Crocker's report. Hence knowledge of the vegetation occupying 150 000 km² rests largely on one traverse and two studies on the margins.

Concern here is with small scale vegetation pattern. Local variation in the Desert is known to show a pattern concordant with that of soil stability; the mobile sands of the parallel dune crests carry a vegetation contrasting in structure and species composition to those of the more stable lower dune slopes and interdune corridors. This cyclic sequence is reported variously as an alternation of discrete Associations (Crocker 1946; Boyland 1970) or as continuous variation (Wiedemann 1971). Crocker lists several variants, of which the following are most significant. First, in an area "west of the Hay River", the dunes lose some of their regularity, becoming less mobile, and the vegetation pattern accordingly alters. Second, the presence of an *Acacia cambagei*-dominated Association is noted in restricted interdune corridors of the eastern Desert, additional to the usual *Zygochloa paradoxa* (dune crest) and *Triodia basedowii* (slope and corridor) Associations. Despite these variations, the impression remains of "a remarkable consistency" (Crocker 1946, p. 249).

The lack of interest in the vegetation indicated by the dearth of further studies may well stem from this impression. As well, the apparent physiographic uniformity of the area (Madigan 1938) may have led to an assumption of consequent uniformity in the vegetation.

A series of quantitative observations are reported here, taken from seven study sites distributed across the Desert near Lat. 26°S. and aimed at further examination of the nature of the vegetation and the variation in its pattern. The observations also extend sampling to a hitherto largely unreported area. This is the first report dealing in detail with the southern Simpson Desert, and the first in which quantitative information is provided from the Desert

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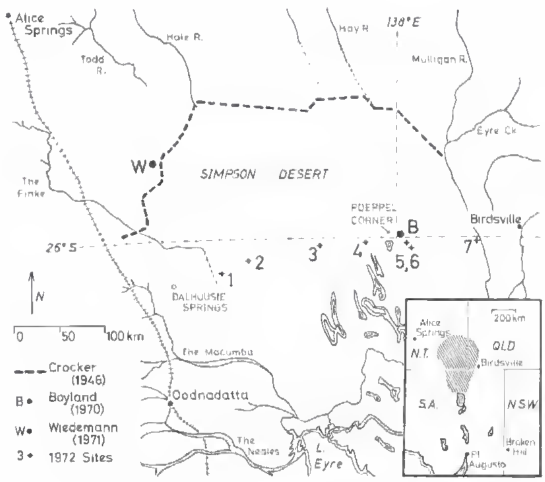

Fig. 1. Simpson Desert and surrounds showing 1972 study sites (numbers), Crocker's (1946) transect (dotted line) and the sites investigated by Boyland (1970) 'B' and Wiedemann (1971) 'W'.

interior. As such it provides a basis for a more accurate ecological assessment of this large but poorly investigated part of the continent.

Study site locations and descriptions

The Desert was traversed by vehicle from West to East in August 1972. A mining exploration track was followed from Dalhousie Springs, S.A., to Poeppel's Corner, and thence towards Birdsville, Qld, along Lat. 26°S (Fig. 1). In contrast to previous studies drought conditions prevailed before and during the crossing.

Observations were made at seven sites along this traverse (Fig. 1). Sites 1–3 had essentially the same physical characteristics: red regular dunes 10–15 m high, parallel and evenly spaced, unstable only at the crests and separated by sandy or occasionally sandy clay corridors. In the central Desert at site 4, dunes were yellow rather than red, lower than at the previous sites and irregular both in profile and trend, with stable rather than unstable crests. The area was homologous with the section of Crocker's (1946) traverse, already mentioned, west of the Hay River. Sites 5 and 6 were in yellow, regular dunes 15–30 m high, with unstable crests and predominantly clay interdunes, while site 7 was in similar dunes amongst the floodflats of the Mulligan River (Eyre Creek). Sites 1 and 7 were both grazed by domestic cattle, watering in the first case from Purni Bore (an uncapped artesian well sunk in 1961): and in the second from numerous waterholes in the Mulligan. Other sites were essentially ungrazed except by occasional small rabbit populations. Low open woodlands were found on interdune flats with sandy clay soils at sites 5 and 6 (*Acacia cambagei*) and at site 7 (*Eucalyptus microtheca*).

Methods

At all but site 6, a single belt transect of contiguous 4 m x 1 m quadrats was laid across the trend of the dunes, incorporating at least one complete topographic cycle. The incidences of all recognisable species encountered were scored, and the information processed by Influence Analysis (Lange 1968). Those unfamiliar with this technique should see also Barker & Lange (1969) and Lange (1971). Species were identified with reference to the checklist of Symon (1969).

At site 6, species' densities were sampled. The topographic profile was divided into four categories: dune crest (unstable sand), slipslope (steep eastern dune face, semi-stable sand), backslope (gentle western face, stable sand) and flat (interdune corridor, sandy clay loam overlying sandy clay). Three parallel transects, 400 m apart, were run across a profile comprising three crests, two backslopes and slipslopes, and one clay flat. Along the transects were laid 66 20 m x 1 m quadrats at regular intervals within categories, each at right angles to the transect. Slipslopes and crests were more intensively sampled relative to the ground area they represented, to approximate the sample sizes obtained on the other categories. All recognisable species were scored.

Results

Species' occurrences

Fifty-two species were found in quadrats (Table 1) from 87 species observed during the crossing (Appendix 1), but only nine species were common to all sites. These were the grasses *Aristida browniana, Enneapogon avenaceus, Eragrostis dielsii, Zygochloa paradoxa* and the herbaceous species *Atriplex limbata, Goodenia cycloptera, Salsola kali, Sida virgata* and *Tribulus hystrix*. Of these, *S. kali, E. avenaceus* and *A. browniana* were generally the most abundant, although usually individuals were dead. *Triodia basedowii*, supposedly the "most important plant in the Desert" (Crocker 1946), was absent from sites 4, 5 and 6, and present only at low frequencies at sites 3 and 7.

TABLE 1.
Relative frequencies of species' occurrences at study sites.

No.	*Species*	*Relative frequency (%) at sites**						
		1	*2*	*3*	*4*	*5*	*7*	*6*
	Group I: species showing significant positive association and found on stable soils.							
1	*Abutilon otocarpum*	29	30	—	—	26	10	—
2	*Aristida browniana*	22	83	62	43	80	57	+
3	*Atriplex limbata*	24	—	21	76	1	30	+
4	*Babbagia acroptera*	—	—	5	—	—	—	+
5	*Dissocarpus paradoxa*	—	—	19	—	—	—	—
6	*Sclerolaena wilsonii*	69	—	49	—	—	51	+
7	*Enneapogon avenaceus*	9	44	74	31	77	72	+
8	*Eremophila longifolia*	—	—	—	—	—	12	—
9	*Euphorbia wheeleri*	—	26	8	14	—	—	—
10	*Goodenia cycloptera*	60	37	15	55	3	18	+
11	*Leschenaultia divaricata*	4	5	1	2	—	—	—
12	*Phyllanthus fuernrohrii*	13	25	5	12	3	1	—
13	*Triodia basedowii*	41	56	8	—	—	3	—
	Group II: species showing significant positive association and found on unstable soils.							
14	*Enneapogon cylindricus*	—	16	—	2	—	—	—
15	*Eragrostis dielsii*	16	16	59	19	23	27	+
16	*Myriocephalus stuartii*	—	21	—	57	28	18	+
17	*Plagiosetum refractum*	—	28	35	55	16	18	+
18	*Ptilotus latifolius*	—	14	3	2	—	—	+
19	*Ptilotus polystachyus*	9	33	15	12	1	3	—
20	*Helichrysum ambiguum*	—	14	—	14	—	—	—
21	*Tribulus hystrix*	2	4	40	50	20	28	+
22	*Zygochloa paradoxa*	11	21	13	43	10	3	+
	Group III: species not displaying significant association; variable soil relationships.							
23	*Acacia cambagei*	—	—	—	—	—	—	+
24	*Acacia dictyophleba*	—	—	—	—	5	6	+
25	*Acacia ligulata*	—	7	—	7	5	—	—
26	*Acacia murrayana*	—	—	1	2	1	6	+
27	*Astrebla* sp.	—	—	11	—	—	—	—
28	*Atriplex inflata*	—	—	—	7	—	—	—
29	*Atriplex holocarpa*	—	—	1	—	—	—	—
30	*Atriplex vesicaria*	—	—	13	—	—	—	—
31	*Sclerolaena divaricata*	—	—	1	—	—	—	—
32	*Cassia nemophila* var *nemophila*	2	—	4	—	—	—	—
33	*Crotalaria cunninghamii*	—	—	—	—	—	—	+
34	*Crotalaria novae-hollandiae*	—	—	—	12	1	6	+
35	*Dactyloctenium radulans*	—	—	16	4	1	1	—
36	*Dicrastylis costelloi*	—	—	—	—	—	—	+
37	*Dodonaea attenuata*	—	3	—	—	38	—	+
38	*Eragrostis ?laniflora*	—	—	—	—	—	—	+
39	*Eremophila macdonnellii*	—	9	7	—	3	—	+
40	*Frankenia* sp.	—	—	—	—	—	—	+
41	*Maireana aphylla*	—	—	4	—	—	—	—
42	*Calotis erinacea*	—	30	—	—	—	1	+
43	*Portulaca oleracea*	—	—	—	—	—	—	+
44	*Ptilotus atriplicifolius*	9	17	1	14	—	—	—
45	*Rhagodia spinescens* var *deltophylla*	—	—	—	—	—	—	+
46	*Salsola kali*	80	65	48	86	69	25	+
47	*Scaevola depauperata*	11	5	—	4	—	—	—
48	*Sida corrugata*	13	28	9	6	—	—	—
49	*Sida virgata*	42	60	64	55	16	15	+
50	*Swainsona rigida*	—	—	—	—	—	—	+
51	*Tragus austalianus*	—	—	3	—	1	4	+
52	*Trichodesma zeylanicum*	—	—	11	17	11	3	+

* Presence only is indicated for site 6, as the sampling system used was not comparable with that at other sites.

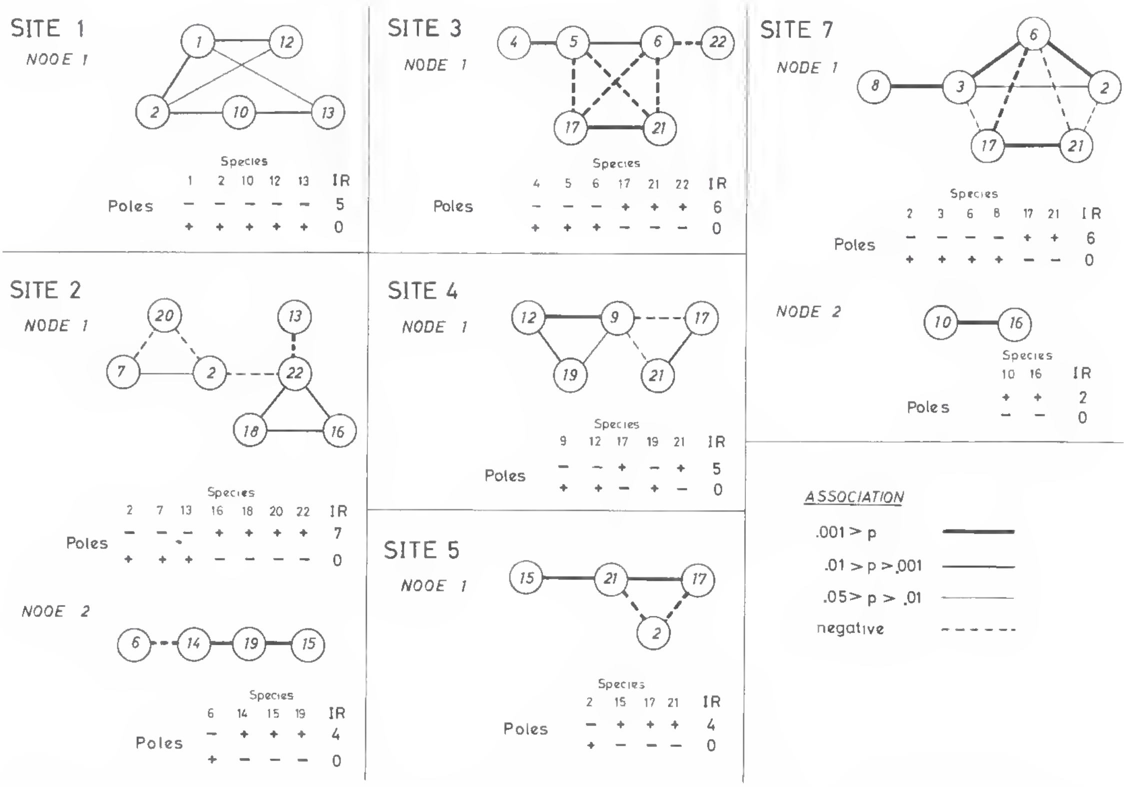

Fig. 2. Nodes of association, poles of interaction and assigned Influence Ratings (IR's) for each sample. Species numbers are those of Table 1.

Interdune corridors with sandy clay as the predominant soil type were sampled at sites 2, 3, 5, 6 and 7, but did not noticeably alter the array of species encountered except at the site 3. Here, a low open shrubland of *Atriplex vesicaria* was found in one corridor with the only occurrences in quadrats of the chenopods *A. vesicaria, A. holocarpa, Sclerolaena divaricata, Dissocarpus paradoxa, Maireana aphylla* and the Mitchell Grass *Astrebla* sp. Low open woodlands on clay flats at sites 5 and 6 (*Acacia cambagei*) and site 7 (*Eucalyptus microtheca*) certainly altered the appearance of the vegetation but had little influence on the understorey species list. Trees at these latter sites were well spaced—at site 6, *A. cambagei* occurred in four of 14 quadrats laid in the woodland, but no trees were found in quadrats at other sites.

Influence Analyses of vegetation pattern

The nodes of species association and the assignment of Influence Ratings (IR's) are shown in Fig. 2. Small quadrat size and low replication limited the degree of reinforcing within nodes—statistical associations tended to appear as chains rather than webs of associated species—but the outline of associations is clear. Twenty-two species contributed to the nodes detected, although not all at any one site. Enough combinations exist, however, to indicate the pattern of association most likely to arise if all species were to be present simultaneously. Given this, the species of Table 2 are divided into three groups, the first two having within-group positive association but with negative association between groups. Group III represents species which because of their low abundance or ubiquitous distributions showed no significant association.

On the basis of their constituent species, groups I and II conform respectively to the *Triodia basedowii* and *Zygochloa paradoxa* Associations of Crocker (1946), the former associated with the stable soils of slopes and corridors, and the latter with the unstable sand of dune crests.

In Fig. 3, Influence Ratings (IR's) are backplotted against distance for the individual nodes at each site. For consistency in presentation, IR's have been assigned so that a high

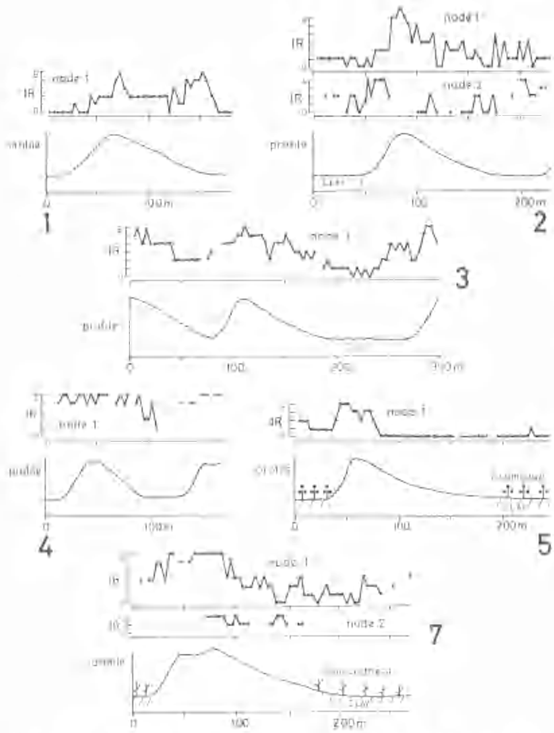

Fig. 3. Influence Ratings backplotted against length of transect for 6 sites in the Simpson Desert. Breaks in the plots indicate quadrats with no score. The accompanying topographic profiles are diagrammatic only and are laterally distorted (see text).

IR indicates that expression of the influence favouring group II species. Points on the plot are evenly spaced for clarity: since the quadrats followed the ground contour, the accompanying sketches of the transect profile are distorted accordingly.

In areas of regular, ungrazed dunes (sites 2, 3 and 5), the major influence of soil stability is clearly shown by the backplots of the first node at each site. A pronounced cyclic vegetation exists parallel to the topographic cycle and so to soil stability. Crests and upper dune slopes display the highest IR's, with lower values for the lower slopes and interdunes. A further node is found at site 2, apparently indicating a secondary influence associated with the base of the slipslope.

The backplot for node 1 at site 7 also shows the influence of soil stability in the same manner, while a second node indicates an undetermined influence associated with upper dune slopes. There is no evidence in the analysis of any perturbations which might be ascribed to domestic grazing, although the frequencies at which species occurred were generally lower here than elsewhere (Table 1).

At site 1, the transect ran across one dune into the corridor containing Purni bore and its drain, on which cattle were concentrated. As in the previous cases, IR's increase to a maximum on the mobile dune crest, then decrease along the backslope; but where the dune merges into the corridor, near the bore drain, IR's again increase to a level as high as that found on the crest. The influence displayed must be soil stability, given the pattern of the first half of the transect, hence the rest of the plot indicates that the corridor-dune junction has become as unstable as the crest.

Compared with other sites, the vegetation was relatively uniform in the irregular dunes at site 4. Overall high IR's along the transect suggest a high degree of instability, but while

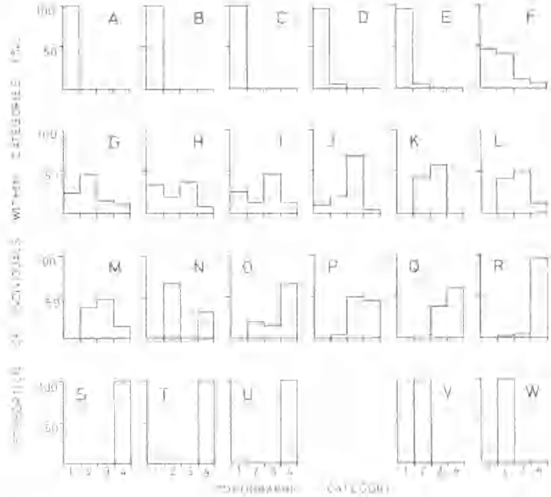

Fig. 4. Proportional distribution of individuals for each species on topographic categories at site 6, corrected for equivalent sample size in each category. Categories: 1, clay flat, stable soils; 2, backslope, stable sand; 3, slipslope, semi-stable sand; 4, dune crest, mobile sand. Species: A, *Acacia cambagei;* B, *Tragus australianus;* C, *Dicrastylis costelloi;* D, *Sclerolaena wilsonii;* E, *Atriplex limbata;* F, *Aristida browniana;* G, *Sida virgata;* H, *Enneapogon avenaceus;* I, *Salsola kali;* J, *Portulaca oleracea;* K, *Acacia murrayana;* L, *A. dictyophleba;* M, *Trichodesma zeylanicum;* N, *Swainsona rigida;* O, *Goodenia cycloptera;* P, *Tribulus hystrix;* Q, *Plagiosetum refractum;* R, *Crotalaria cunninghamii;* S, *C. novae-hollandiae;* T, *Ptilotus latifolius;* U, *Zygochloa paradoxa;* V, *Calotis erinacea;* W, *Dodonaea attenuata.* For densities refer Appendix 2.

evidence at the site indicated recent deflation (e.g. wind-cut plinths around the bases of perennial bushes) the dunes appeared to be much more stable than at the other sites, with very little mobile sand present.

Density distributions

Only seven species at site 6 were restricted entirely to a particular topographic category: *Acacia cambagei, Tragus australianus* and *Dicrastylis costelloi* on clay flats, *Calotis erinacea* and *Dodonaea attenuata* on backslopes, and *Crotalaria novae-hollandiae, Ptilotus latifolius* and *Zygochloa paradoxa* on mobile dune crests. Although other species showed a preference for a particular category, considerable overlap occurred. A continuous gradient in species' incidence and abundance relative to the categories is in fact displayed by Fig. 4, in which the species restricted to flats and crests respectively represent the two extremes of the gradient. (*C. erinacea* and *D. attenuata* do not appear to fit in the sequence, but this may result from minimal abundances—see Appendix 2.)

Essentially, the findings replicate the results of analyses already given. Most species distributions relate to the primary influence of soil stability in the manner expected from the Influence Analyses. Two exceptions are *Eragrostis dielsii* and *Goodenia cycloptera* which at this site show a preference for stable and unstable soils respectively.

Discussion

The nature of the communities

The continuous variation highlighted by analyses supports Wiedemann's (1971) contention of a vegetation continuum along the dune-interdune cycle rather than a separation into more-or-less distinct associations as proposed by Crocker (1946) and Boyland (1970). The continuum relates directly to soil stability, the major and often only influence detected. Further, the type of substrate appears to have little effect on the expression of this continuum. Clay-dominated soils in interdune corridors at sites 2, 3, 5 and 7 introduced no perturbations to plots of the influence, and only at site 3 was the array of species present significantly altered by the increased soil diversity. Species restricted to clay soils at site 6 appear to represent more an extreme of a sequence encompassing both sand and clay soils than a group in their own right. Thus even the *Acacia cambagei* woodlands at sites 5 and 6 could be considered as part of the one continuum rather than a distinct Association, despite the major and obvious differences in substrate and appearance. Separate classification and mapping, not only of dune Associations but also of these woodlands, may be convenient for rapid and subjective appraisal but misleading in terms of the system's operation: the trees catch the eye but are unlikely to be exerting much influence on the rest of the vegetation because of their wide spacing (see also Wiedemann 1971).

Wiedemann (1971), as well as demonstrating the existence of the above continuum at his study area, also defined a number of "habitat types". Some support for this curiously ambivalent reclassifying of the vegetation might be seen in the present study, in that the influences expressed by node 2 at site 2 and node 2 at site 7 may correspond to his "lower slope clayey sand" and "mid-slope clayey sand" habitats. However, the results given here show that these variations are minor indeed by comparison with the over-riding influence of soil stability.

Variation in vegetation pattern between sites

The cyclic pattern in the vegetation is clearly not consistent across the Desert. Three sources of variation are found: in the species present at any one site, in landform, and in the impact of domestic stock. Much of the first source may stem from differences in the levels of sampling replication or in time since last plant growth, but differences due to varying distributions on a biogeographic scale were also noted. Although a discussion of the last is beyond the scope of this paper, the absence of *Triodia basedowii* from the central Desert sites warrants mention in view of the reported importance of the plant. In the western Desert, *T. basedowii* is the most frequently encountered perennial, and Crocker (1946) and Wiedemann (1971) indicate its significance as an influence on other species present. Hence changes in the distribution of associated species would be expected to accompany its disappearance.

The absence of a clearly defined vegetation pattern at site 4 reflects differences in landform between this and other parts of the Desert: differences which are not confined to the southern Desert but apparently extend to the latitude of Crocker's crossing. The results are confusing: the site showed at the same time evidence of recent deflation and an absence of mobile sand, while analysis of the vegetation suggests that it was more unstable, area for area, than any of the other sites. The peculiarities of this part of the Simpson dune system require further investigation.

Domestic grazing on the Desert fringes has had a decided impact. Wiedemann (1971) suggested that the landscape's stability was relatively unaffected by the level of plant cover, but the effects of cattle grazing at Purni Bore suggest otherwise. Stock movement and feeding on the lower dune slopes at site 1 have increased sand mobility to a level equivalent to that of the dune crests. Certainly this is a case, albeit local, where the removal of vegetation has led to greater instability. Additionally, the sand-binding value even of dead plants is often under-estimated. At site 5, ephemeral species (particularly *Salsola kali*) were so long dead as to have turned black, yet were still binding the lower slopes of the dunes (see also Crocker 1946). Nearer Birdsville, dunes have deflated and shifted following grazing, as shown by *Acacia cambagei* trees of the flats in process of burial. The impression still remains one of fragility, with the plant cover a major factor in dune stabilisation.

The lesser impact of stock at site 7 probably results from a greater dispersion of animals. At this site, changes in vegetation patterns due to stock were not detected, but an overall reduction in frequencies of occurrence was noted, relative to other sites.

Comparison with Crocker's (1946) descriptions

In general terms, the local vegetations at the latitude of the 1972 crossing are much the same as those described by Crocker (1946) for a lower latitude. Differences stem more from the approaches and emphases of observers than from the vegetation itself. However, the irregular dune system represented by site 4 would appear to be in greater contrast with the rest of the Desert than Crocker indicated; while the *Acacia cambagei* woodlands, noted on "restricted" corridors in the eastern Desert by Crocker, appear to be a more widespread component of the vegetation in the southern Desert. The latter has been noted also by Boyland (1970). These reservations apart, observations at intermediate latitudes can be expected to return equivalent results.

Acknowledgments

We wish to thank C. R. Harris and Rob Marshall who organised and led the party; the Department of Geography, University of Adelaide, the Research School of Biological Sciences, Australian National University, the South Australian Department of Agriculture and members of the party for vehicular and financial support; and D. H. Fatchen for the line drawings. Mr D. E. Symon kindly checked nomenclature in the plant lists. At the time of the study, T.J.F. was recipient of a Commonwealth Postgraduate Research Award in the Department of Botany, University of Adelaide, while S.B. was a postdoctoral Fellow in the Research School of Biological Sciences, Australian National University.

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APPENDIX 1

PLANT SPECIES OBSERVED IN THE SOUTHERN SIMPSON DESERT AT LAT. 26°S

* Indicates flowering material verified by the State Herbarium of South Australia.

TYPHACEAE

**Typha domingensis* Pers

GRAMINAE (POACEAE)

**Aristida browniana* Henr.
A. contorta F. Muell.
Enneapogon avenaceus (Lindl.) C. E. Hubbard
E. cylindricus N. T. Burb.
Eragrostis dielsii Pilger
E.? laniflora Benth.
**Plagiosetum refractum* (F. Muell.) Benth.
Tragus australianus S. T. Blake
Triodia basedowii E. Pritzel
**Zygochloa paradoxa* (R. Br.) S. T. Blake

CYPERACEAE

**Cyperus laevigatus* L.
**C. gymnocaulos* Steud.

PROTEACEAE

Grevillea juncfolia Hook.
**Hakea divaricata* Johnson
H. leucoptera R. Br.

SANTALACEAE

Santalum lanceolatum var. *angustofolium* R. Br.

CHENOPODIACEAE

Atriplex inflata F. Muell.
**A. limbata* Benth.
A. nummularia Lindl.
A. holocarpa F. Muell.
A. vesicaria Heward ex Benth.
Babbagia acroptera F. Muell. & Tate
**Dissocarpus paradoxa* (R. Br.) F. Muell. ex Ullrich
Maireana aphylla (R. Br.) P. G. Wilson
M. astrotricha (L. A. S. Johnson) P. G. Wilson
M. pyramidata (Benth.) P. G. Wilson
Rhagodia spinescens var. *deltophylla* (F. Muell.) Black
**Sclerolaena andersonii* (Ising) Scott
**S. bicornis* Lindl.
S. divaricata (R. Br.) Domin
S. muricata (Moq.) Domin
**S. wilsonii* (Ising) Scott
**Salsola kali* L.

AMARANTHACEAE

Ptilotus atriplicifolius (Cunn. ex Moq.) Benth.
**P. latifolius* R. Br.
**P. obovatus* (Gaudich) F. Muell.
**P. polystachyus* (Gaudich) F. Muell.

AIZOACEAE

Aizoon quadrifidum (F. Muell.) F. Muell.
**Trianthema pilosa* F. Muell.

PORTULACACEAE

Portulaca oleracea L.

MIMOSOIDEAE

**Acacia cambagei* Baker
**A. dictyophleba* F. Muell.
**A. ligulata* Cunn. ex Benth.
A. linophylla Fitz.
**A. murrayana* F. Muell. ex Benth.
A. oswaldii F. Muell.
A. tetragonophylla F. Muell.
A. victoriae Benth.

CAESALPINIOIDEAE

Bauhinia carronii F. Muell.
**Cassia nemophila* var. *nemophila* (Cunn. ex Vogel) Symon
C. nemophila var. *zygophylla* (Benth.) Symon

PAPILIONATAE

**Crotalaria cunninghamii* R. Br.
**C. novae-hollandiae* DC.
**Psoralea eriantha* Benth.
Swainsona rigida (Benth.) Black

ZYGOPHYLLACEAE

Nitraria billardieri DC.
Tribulus hystrix R. Br.
**Zygophyllum billardieri* DC.

EUPHORBIACEAE

Euphorbia drummondii Boiss
**E. wheeleri* Baill.
**Phyllanthus fuernrohrii* F. Muell.

SAPINDACEAE

Atalaya hemiglauca (F. Muell.) F. Muell. ex Benth.
Dodonaea attenuata Cunn.

MALVACEAE

**Abutilon otocarpum* F. Muell.
Sida corrugata Lindl.
S. virgata Hook.

UMBELLIFERAE (APIACEAE)

**Trachymene glaucifolia* (F. Muell.) Benth.

THYMELEACEAE

**Pimelea ammocharis* F. Muell.

MYRTACEAE

Eucalyptus microtheca F. Muell.

BORAGINACEAE

Trichodesma zeylanicum (Burm. f.) R. Br.

CHLOANTHACEAE

**Dicrastylis costelloi* Bailey

MYOPORACEAE

**Eremophila longifolia* (R. Br.)
**E. macdonnellii* F. Muell.
**E. willsii* F. Muell.

GOODENIACEAE

**Goodenia cycloptera* R. Br.
**Leschenaultia divaricata* F. Muell.
**Scaevola collaris* F. Muell.
**S. depauperata* R. Br.

COMPOSITAE (AESTERACEAE)

**Calotis erinacea* Steetz
**Calocephalus knappi* (F. Muell.) Ewart et White
**Helipterum floribundum* DC.
**Helichrysum ambiguum* Turoz.
**Myriocephalus stuartii* (F. Muell. and Sond ex Sond) Benth.
**Senecio gregorii* F. Muell.

APPENDIX 2
DENSITY DATA FROM SITE 6

Mean densities with associated standard errors for species on each of the topographic categories at site 6. The order of species is as in Fig. 4. Values are in plants per 10 m^2.

Category:	*Flat*	*Backslope*	*Slipslope*	*Crest*
Sample size:	*14*	*22*	*12*	*18*
Species				
Acacia cambagei	0.2 *	—	—	—
Tragus australianus	0.4 ± 0.70	—	—	—
Dicrastylis costelloi	0.1 *	—	—	—
Sclerolaena wilsonii	8.1 ± 2.07	0.1 *	—	—
Atriplex limbata	1.8 ± 1.44	0.1 *	—	—
Aristida browniana	48.5 ±12.67	41.4 ± 2.58	10.0 ± 4.95	3.3 ± 0.87
Sida virgata	1.5 ± 0.89	2.9 ± 1.00	0.9 ± 0.47	0.8 ± 0.27
Enneapogon avenaceus	9.1 ± 1.79	4.9 ± 1.03	9.7 ± 2.13	2.3 ± 0.87
Salsola kali	10.2 ± 2.15	5.0 ± 0.80	17.7 ± 6.10	4.9 ± 1.83
Portulaca oleracea	3.1 ± 1.56	5.7 ± 3.44	19.0 ± 3.75	0.2 ± 0.17
Acacia murrayana	—	0.2 ± 0.07	0.2 *	—
Acacia dictyophleba	—	0.3 ± 0.13	0.4 ± 0.11	0.1 *
Trichodesma zeylanicum	—	11.0 ± 2.24	13.6 ± 2.57	3.8 ± 1.46
Swainsona rigida	—	0.7 ± 0.31	—	0.4 ± 0.30
Goodenia cycloptera	—	1.3 ± 0.60	0.8 ± 0.55	4.0 ± 1.43
Tribulus hystrix	—	0.1 *	1.7 ± 0.80	1.5 ± 0.48
Plagiosetum refractum	—	0.1 *	2.0 ± 0.90	3.1 ± 0.97
Crotalaria cunninghamii	—	0.1 *	0.1 *	1.9 ± 1.88
Crotalaria novae-hollandiae	—	—	—	0.5 ± 0.18
Ptilotus latifolius	—	—	—	0.4 ± 0.28
Zygochloa paradoxa	—	—	—	2.0 ± 0.45
Calotis erinacea	—	—	0.1 *	—
Dodonacea attenuata	—	—	0.2 ± 0.08	—
Babbagia acroptera	a	—	—	—
Eragrostis ?laniflora	a	—	—	—
Frankenia sp.	a	—	—	—
Myriocephalus stuartii	b	b	b	b

* denotes less than 5 occurrences, 'a' a single occurrence and 'b' fragments.

ALOCOSTMA NEW GENUS (NEMATODA: TRICHONEMATIDAE)

BY PATRICIA M. MAWSON

Summary

Alcostoma is related to the genera Macropostrongylus and Macroponema. It is distinguished by the presence of longitudinal striae in the anterior part of the lining of the buccal cavity, and by the very distinctive cylindrical submedian cephalic papillae. A diagnosis is given of the new genus, as well as a partial redescription of the type species, Cyclostrongylus clelandi.